SYNTHETIC APERTURE MICROWAVE RADIOMETER

by

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Realizing the full potential of microwave remote sensing from space requires putting relatively large antennas in orbit. For example, in order to measure soil moisture, an important element in the global hydrologic cycle, an antenna on the order of 20 meters on a side would be required in space as part NASA,s Earth Observing System (Eos). Research is being conducted to develop synthetic aperture antennas to reduce the physical collecting area required of sensors in space, and to possibly open the door to new applications of microwave remote sensing.

The technique under investigation involves using a correlation interferometer with multiple baselines and is similar to "earth rotation synthesis" developed in radio astronomy. In this procedure the product of the voltages from a pair of antennas is measured coherently (amplitude and phase are detected). This correlation is proportional to the Fourier spectrum of the scene evaluated at a frequency which depends on the spacing between the antennas. By making measurements at many spacings, one can "map" the spectrum, and then the scene itself can be obtained by taking the inverse Fourier transform. The important consideration for remote sensing purposes is that the resolution obtained depends on how well the Fourier spectrum has been sampled (i.e., on the distribution of baselines at which measurements have been made) and not on the size of the antennas actually employed in these

measurements. Thus, one can use small antennas with measurements at many baselines and achieve the resolution of a single antenna with a much larger aperture.

The Microwave Sensors and Data Collection Branch has been engaged in research to develop this technique for applications to remote sensing of soil moisture from space. Soil moisture is important for agricultural applications and for understanding the global hydrologic cycle.

We now have an aircraft prototype of an instrument suitable for making such measurements. This is an L-band radiometer called "ESTAR" which we hope will become part of the Earth Observing System (Eos). ESTAR is a hybrid instrument which uses both real aperture antennas (long sticks to obtain resolution in the along-track dimension) and aperture synthesis (correlation between sticks to obtain resolution in the cross track dimension). The hybrid was chosen as a compromise to increase the sensitivity (T) of the instrument.

ESTAR made its maiden flight in February 1988, aboard the NASA P-3 out of Wallops Flight Facility. We hope to be making soil moisture measurements over test fields by the end of the Summer 1988.

This research is a cooperative effort involving the Goddard Space Flight Center, the Microwave Remote Sensing Laboratory at the University of Massachusetts and the Hydrology Laboratory of the U. S. Department of Agriculture.